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INTERGRAPH



(NASA-CR-171587) ANALYSIS OF SPACECRAFT
DATA Final Technical Report (Intergraph
Corp.) 8 p HC A02/MF A01 CSCL 09B

N85-32789

Unclas
G3/61 21966



Analysis of Spacecraft Data

Final Technical Report

Contract Number: NAS8-34005

IC/FSD85-032

1 June 1984

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1. SPACECRAFT DATA ANALYSIS OVERVIEW

During the contract period, support was provided for the maintenance and modification of software for the production and detailed analysis of data from the DE-A spacecraft and new software developed for this purpose.

1.1 New and Modified Software

A capability was developed to do interactive processing of DE-A plasma wave instrument (PWI) mission analysis files (MAF) on the Tektronix 4027 color CRT. Two programs were written to facilitate this capability:

a) SFRANL: This program reads the PWI-MAF and produces a file of the necessary information to plot the data and to be used as a lookup table when in the interactive mode of SFRPLT.

b) SFRPLT: This program reads the file produced by SFRANL and creates a color spectrogram on the 4027. When in the interactive mode, cross hairs are displayed which can be controlled via the directional arrows on the 4027. The (X,Y) values of the position of the cross hairs are converted to record number and word number which are used as an index for looking up data in the SFRANL file. The data obtained from the file is continuously being updated and displayed on the 4027. If the operator wishes, SFRPLT will use the values obtained from the SFRANL file to calculate additional values to be displayed on the spectrogram and written to a second file. If a mistake is made he may correct the second file and the spectrogram or he may restore the second file and the spectrogram to their preprocessed values.

Intergraph personnel modified and verified the algorithm for the calibration lookup table for the PWI data. A production program to generate color FR80 spectrograms of the PWI data was written. This is called PWPLTP. The two above mentioned programs, SFRANL and SFRPLT, were combined and modified with SFRPLT being a subroutine to SFRANL. This program has the capability to plot the raw data numbers, or by use of the above mentioned calibration look up table plot spectral density or power flux for the three electric antennas or gamma for the loop.

The program RLTVBE which uses the plasma wave instrument data as input was written. The sequence of processing is as follows: First, the time of each magnetic field instrument data and each PWI sample is calculated. The angle between the PWI electric antennas or loop and the magnetic field direction is computed using these times, the spacecraft coordinates of the magnetic field sample, and the angle between the electric antennas or the loop and the +X axis of the spacecraft. A polar plot of electromagnetic field strength versus this angle is then created. A first order fourier analysis is performed on the calculated data (field strength vs angle) creating an offset, amplitude, and gain of the sine wave the calculated data represents. A cartesian plot is then created displaying the fit, obtained via the fourier analysis, overlaid on the calculated data.

The programs CESPEC and CSSPEC were modified so that instead of writing output files for each plot generated, all the output from a session is written to the same file with indicators showing which data goes with which plot. Also, since these are sister programs, one plots counts vs energy and the other plots counts vs spin, they were modified so that they are as nearly identical as possible as far as user input and output.

Modifications were also made to two modeling programs MESPEC and MSSPEC so that they could read the new format of the output from CESPEC and CSSPEC, respectively, and give the user the option of accepting or rejecting each set of data from this file. MESPEC was also modified to use fluxes or counts as input and output, it was also modified to do optional curve fitting analysis, the user gives the program the initial parameter values and if he wishes these values can be passed to the curve fitting subroutine and by altering these values until chi-squared is minimized find improved values. MSSPEC was also modified so that it is compatible with its sister program MESPEC. This included the inclusion of the ASK and IASK subroutines, and the plotting options for the Y-axis to include the minimum and maximum values to be plotted and whether the scale is to be linear or logarithmic.

PORB, a program which plots the orbit of the DE-A spacecraft in various coordinate systems, was modified to be capable of plotting predicted orbits beyond the orbital data which is provided by Goddard Space Flight Center.

A plotting subroutine^Y was written to complement a previously written program, FREQ. This subroutine uses the color and pie fill capabilities of the Tektronix 4027 terminal to produce a polar contour plot.

Work was performed on a program for the Retarding Ion Mass Spectrometer (RIMS) data. This program, ENSP3D, is a combination of and modification of the three previously written programs, CESPEC, CSSPEC, and RPASGS, which plot counts vs energy, counts vs ram spin angle, and ram spin angle vs energy vs counts, respectively.

The DE-A S/C software library was copied to the MACS IBM 4341 at Goddard Space Flight Center, this was done via tape and mailed to operations at GSFC for insertion into the IBM and involved some 400 modules. Due to the different compiler used on the IBM, some of the modules had to be rewritten to be compatible with their compiler. The program to copy RIMS MAF to tape in the proper format with correct header, for shipment to and insertion into the data base on the IBM, was completed. The validity of the data was tested using the program LSTMF1 and approval was given for production and shipment of MAF's to GSFC.

Intergraph personnel kept the O/A data base updated, and technical consultation was supplied relative to various aspects of the DE-A S/C data analysis effort.

2. SYSTEMS SUPPORT OVERVIEW

As part of this contract, Intergraph provided:

- 1) DSTP Support
- 2) VAX System Management
- 3) SPAN Management.c

2.1 DSTP Support

NASA's Data System Technology Program (DSTP)/Data Base Management System (DBMS) is a technology tested used to procure, test, and evaluate state-of-the-art data systems hardware and software. The DBMS is composed of three superminicomputers, two minicomputers, and a Mass Memory Archive (MMA) tied together with a high speed fiber optics bus and custom systems software. During the duration of this contract, the entire DBMS was present with the exception of the MMA. In order to be able to test the system in the MMA's absence, it was emulated by utilizing two large magnetic disk drives. A fairly large number (upwards of 6000) Dynamics Explorer (DE) Retarding Ion Mass Spectrometer (RIMS) packets were archived on the IAMM (Interim MMA) for DBMS testing. A number of both hardware and software problems were experienced with the system during this time, many of which Intergraph personnel solved in cooperation with the original DBMS contractor, OAO. Several module updates from OAO were delivered during this time period and they were applied to the various DBMS subsystems. The applications library for use on the DBMS also grew during this period.

Intergraph personnel have been involved in the DSTP for the entire duration of the contract. At various times during the contract, Intergraph personnel have performed system management as well as hardware, software, and integration support for personnel of both RCA and OAO.

2.2 VAX System Management

One of the superminicomputers associated with the DMBS differs from the rest of the DMBS computer systems in that it is used as a general purpose time sharing machine by a large community of NASA civil service and contractor personnel. For the duration of this contract, Intergraph personnel have acted as the "system manager" for the DIGITAL VAX 11/780 that is known as the Packet Management System (PMS) to the DBMS or NEEDS (NASA End to End Data System) to the network. Some of the regular duties performed include user consulting, interfacing with vendor field representatives for hardware support, installing new versions of the VAX/VMS operating system, installing new versions of layered software products such as VAX-11 FORTRAN, VAX-11 Pascal, DECnet-VAX, etc., maintaining the user authorization data base, monitoring and controlling the allocation and utilization of system resources such as disk space, CPU time, memory, etc., analyzing system accounting files to detect unauthorized system use, doing regular compressions of system disk packs, ensuring scheduled system backups are performed, etc.

2.3 SPAN Management

The final major area of Intergraph activity on this contract is concerned with the Space Physics Analysis Network (SPAN). SPAN is a wide-area DECnet network which links together DIGITAL computers used for spacecraft data analysis at universities, corporations, and national laboratories located across the country. Intergraph personnel are responsible for configuration, performance, and management of the SPAN.

During this contract period, the SPAN grew from a total of 8 nodes to around 15 nodes. A number of new institutions were brought on the network while a number of new machines were brought online on LAN's at existing SPAN sites.

During this contract Intergraph personnel represented Marshall Space Flight Center's Space Science Laboratory at the Planetary Data Workshop held at Goddard Space Flight Center. This conference had special relevance to the SPAN since it's findings would probably guide a parallel NASA network that has interconnects with the SPAN. Another meeting where Intergraph personnel represented MSFC was the Los Alamos National Laboratory "Duplicate Node Number" meeting. This meeting was arranged to attempt to come up with a solution to the problem of duplicate node numbers experienced by both SPAN and Los Alamos.